

there is no adequate ground for assuming that a limit such as that of the series of rationals whose squares are less than 2 does really exist. Instead of this Mr. Russell defines a *segment* as a class of rationals less than a variable term of itself, and shows that segments possess all the usual properties of real numbers. This theory agrees very closely with Cantor's, the point of divergence being where Cantor appears to regard the rational number  $a$  as identical with the real number defined by the series  $(a, a, a, \dots)$  whereas Mr. Russell will not admit this. On the one hand it is obvious that the two concepts are as distinct as "man" and "featherless biped," and therefore cannot be identical; but, on the other hand, it seems unnecessary to insist too much on the distinction, because no confusion need arise from using the expression " $a$ " in two different senses. Thus, if  $b$  is the irrational number defined as the series  $(\dots a_n, a_{n+1}, \dots)$  we may write  $b - a = (\dots a_n - a, a_{n+1} - a, \dots)$  and in this equation  $a$  is a series or so-called real number on the left and a rational number on the right. The conclusion is that the series of rational numbers cannot be completed exactly as it stands, but the rationals must first be replaced by series, or, if preferred, by segments, and then by means of other series the continuum of real numbers can be constructed.

Limitations of space forbid detailed comment on part vi., in which, incidentally, Euclid gets some rather hard knocks; and in the matter and motion of part vii. Newton's laws are condemned as confused, worthless, and wholly lacking in self-evidence, while we are told that force is a mathematical fiction, and velocity and acceleration must not be regarded as physical facts.

On the whole the book is very interesting, although somewhat too long. The presentation is admirably clear, and the seriousness of the style is relieved here and there by neatly turned bits of humour. It does not pretend to say the last word on any subject, and, indeed, bristles with unsolved difficulties, towards the correct solution of which a great step is undoubtedly made by its publication.

R. W. H. T. H.

#### ELECTROCHEMICAL ANALYSIS.

*Quantitative Chemical Analysis by Electrolysis.* By Prof. Classen. Translated by Bertram B. Boltwood. Pp. vii + 315. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 12s. 6d. net.

**E**Lectrochemical methods of analysis are now coming into such general use on the Continent and in America, and to a smaller extent in this country, that chemists will be prepared to welcome the latest translation of Prof. Classen's "Quantitative Analyse durch Elektrolyse."

The translation is made from the fourth German edition published in 1897, but, as the translator has been allowed wide latitude by the author, he has brought the book well up to date, and we find several features in this book which are not in the German original.

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In chapters xiii. and xiv., for example, which deal respectively with "measurements of current strength" and "sources of current," there are quite a number of new blocks, as, for example, Bredig's amperemeter and the Weston ammeters and voltmeters. We also find several new diagrams in chapter xvi., which deals with the accessory apparatus employed in analysis. As a matter of fact, we think, considering that the book is devoted to electro-analysis, some of the apparatus described is rather superfluous. A quadrant electrometer is not usually to be found in a laboratory devoted to electro- or any other analysis, the description of such apparatus appertaining more to works on physics or perhaps on general electrochemistry. In chapter xviii. the author gives details as to "arrangements for analysis." The details which are given refer mainly to the very thorough installations at Aachen, and two photo-plates of the laboratories, as they are at present, also one showing the former equipment of the private laboratory, are given. One cannot learn very much from these photographs, but they improve the appearance of the book, and incidentally give an idea of the large number of platinum basins which Prof. Classen possesses.

On p. 153 we come to the analytical portion of the book, the first metal dealt with being iron. For the analysis of iron there is no doubt that Classen's oxalate method is extremely satisfactory, and the analytical results obtained are generally very accurate. At the same time, as Kohn and others have shown, this is really due to a balancing of errors. The iron deposited always contains traces of carbon, but, on the other hand, there is usually a trace of iron left in the solution, and these two errors balance. Classen states that iron, when deposited from solutions containing citrates and tartrates, always contains carbon, but leaves it to be inferred that when oxalates are employed, the metal is deposited free from carbon. Prof. Classen employs the oxalate method not only for iron, but he uses it for almost every metal, very often, too, when other ways are vastly superior, and he seems very much afraid that someone else will take credit for the method, because in almost every case we find a bracket in which it is stated that this is the "method of the author." As a matter of fact, there are only a few cases in which the employment of oxalates has any real advantage, as e.g. with iron and zinc. There is certainly nothing to be gained by using it when depositing copper, nickel, or mercury, where there are many much more satisfactory methods. Cobalt, according to the author, when deposited, shows its characteristic metallic properties. Generally speaking, when electrically deposited, cobalt is brownish or smoky in appearance—are these its characteristic metallic properties?

Section ii. of the analytical portion deals with the analysis of nitrates, and section iii. with the determination of the halogens.

Section iv., on the separation of the metals, is perhaps one of the best parts of the book. It may be very easy, and generally is, provided one employs the correct conditions, to analyse from pure salts of the metals, but the electrolytic separation of metals is

not always so simple. Of course, the chief point is to know how and when to combine pure analytical with electro-analytical methods in such a way as to attain the greatest accuracy, and to save as much time as possible.

Section v. is devoted to a short account of a very neat method of determining the halogens in presence of each other. It depends upon the fact that iodine is precipitated from its solutions at a lower potential than bromine. A silver anode is employed, and when at the lower potential all the iodine has been deposited, a fresh anode is placed in the solution, and a higher E.M.F. employed. Part iii. of the book is divided into two sections, the first of which gives some examples of applied electrochemical analysis, as e.g. analysis of alloys, such as brass, solder, type metal, &c., and of certain ores, such as cinnabar and molybdenite. The second section gives details for the preparation of reagents.

The book in its present form is a very useful addition to laboratory text-books. The introduction is, perhaps, rather unnecessarily long, but it explains Faraday's and Ohm's laws clearly, and gives a good general account of the theories of electrolysis. At the heads of the chapters very full references to the literature of the subject are given; the references are mainly to German and American authors, the reason being that Germans and Americans have done most of the work.

The translator, Dr. Bertram Boltwood, has carried out his labour with care and discretion, and many of his additions are very valuable. The book is splendidly printed, and the diagrams are very clear and well produced.

F. MOILWO PERKIN.

#### TECTONICS OF THE EASTERN ALPS.

*The Geological Structure of Monzoni and Fassa.* By Maria M. Ogilvie-Gordon, D.Sc., Ph.D. Pp. x + 180. (Edinburgh: For the Geological Society of Edinburgh, Turnbull and Spears; London: Simpkin, Marshall and Co., Ltd., 1902-3.)

IT is indeed satisfactory that the Geological Society of Edinburgh has, with considerable enterprise, published the very detailed observations of Dr. Maria Ogilvie-Gordon. We can easily conceive that, when originally presented to the Royal Society of London, this paper seemed of somewhat local application (prefatory note, p. v.), and it is the privilege of societies with fewer claims upon their funds to do justice to the work of their own members. It rests with the author to see that the circulation of separate copies is judiciously carried out, in which case, from a cosmopolitan point of view, the place of publication has little influence on the judgment of scientific men.

One feels, however, that continuous energy and persistent attention to detail on the part of Dr. Ogilvie-Gordon have brought into an important controversy a feature that may be superficial, but which, none the less, jars upon the reader. One becomes inclined to believe that an observation claims our notice because it was made by the authoress, and not because it furnishes a link in the long chain of argument.

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The same impression, it is true, is often produced in the works of Ruskin or Carlyle, but does not form their most enduring attraction for posterity. The recognition of Dr. Ogilvie-Gordon's work is manifest from the frequent references to it by Continental writers, notably in the new "Führer für die Exkursionen," issued for the ninth Geological Congress in Vienna. Yet we cannot forget that the authoress attaches so much importance to the views adopted by her as to have introduced disparaging remarks upon a rival school in the "translation" of a work by Prof. von Zittel. The paper now before us the record of some years of devoted and faithful study in the field, describes how the Triassic masses have been broken up by a double series of planes of fracture, along which igneous rocks have crept during the period of earth-movement. Possibly, then, there is some appropriateness in a mode of treatment which causes us to see the lines of weakness in previous descriptions penetrated with an almost intrusive pertinacity.

Not that there is any note of battle in the present treatise. The authoress gives her reading of the very numerous observations made by her in a classic area, and the difficulties to be faced are well realised by Doelter in the "Führer" above referred to, when he says of Predazzo,

'Die Teilnehmer an dieser Exkursion betreten ein Gebiet, welches zu den allerinteressantesten Europas gehört, aber auch zu denen, wo der Zwiespalt der Meinungen am grössten ist. Die verschiedensten und widersprechendsten Ansichten haben hier geherrscht und herrschen teilweise heute noch.'

Similar caution is shown by Drs. Diener and Arthaber in treating of the "reef-facies" in the Schlern area. With regard to the causes that bring massive limestones into juxtaposition with normal sediments, along surfaces that occasionally interlock, all geologists are aware that Dr. Ogilvie-Gordon has adopted a theory of cross-fracture and faulting (p. 67), and has done so after detailed mapping on the ground. Her views of the Monzoni mass are admirably stated on p. 176 of the present paper.

"I therefore strongly insist upon my observation in the case of Monzoni that the particular band of limestone strata entered by the sill was at the time of inflow *in process of sinking* steeply inward at the inthrust faults . . . While the ascending magma involved and engulfed fragmentary portions of the insinking calcareous rock, it clearly found easiest access amidst the multiplicity of fracture and shear-slip planes in the body of Werfen strata to the south."

The succession of intrusions is then described, and the suggestive conclusion is arrived at (p. 177) that

"during the geological periods when the fault-vent continued intermittently active, the form of the sill-complex was capable of being re-moulded periodically in harmony with the localised crust-stresses."

The Cainozoic age often assigned to the whole eruptive series of Monzoni, which can only be proved to be later than the Lower Trias, is not a vital point in Dr. Ogilvie-Gordon's paper. Its interest lies in its tectonic details, and these are illustrated by a number